

TECHNICAL DATA SHEET

RECOMMENDED CONFIGURATION OF COMBAT LOADS OF 8" M106 ARTILLERY AMMUNITION



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INTRODUCTION

The purpose of this report is to outline an approach to configuring 8" M106 artillery assets aboard transport vehicles such that the maximum credible event, given an explosion of one or more rounds, is limited to a fraction of the assets aboard one vehicle. The configurations described herein are appropriate to storage aboard S&P line haul trailers, the HEMMT truck and HEMATT trailer, 5 ton truck, and 1.5 ton trailers.

BACKGROUND

This effort was conducted as part of the Ammunition Quickload Program, a program initiated by the Department of Defense Explosives Safety Board and sponsored by them and AMC (through PM Ammolog). The purpose of the program was to provide assistance to 8th Army (particularly the 2nd Infantry Division) in improving the safety and survivability of ammunition assets located on rolling stock as part of an enhanced readiness posture. Several types of ammunition are being addressed as part of this program. At the time of program inception, the 2ID had its assets configured as single DODAC combat loads with, for example, TNT filled M106 8" artillery ammunition (with propelling charges and fuzes) collocated upon one set of vehicles, composition B filled M107 155mm artillery assets located aboard another set of vehicles, etc. This particular data package has been shown to be applicable to combat loads of M106 projectiles, with ancillary propelling charges and fuzes. It may very well be applicable to other types of ammunition as well, but such has not yet been demonstrated.

RATIONALE

The configuration design described below uses spacing and shielding to prevent direct propagation of detonation from one set of assets to neighboring sets. The design described was chosen to minimize explosion size, consistent with low cost of shielding, minimum degradation of operational performance capability, and minimal space and weight burdens. It is based upon the realization that the propagation mechanisms which must be defeated are discrete fragment impact and crushing. For propagation of detonation by fragment impact, an effective rule of thumb is that the fragments generated by the detonating source must be slowed sufficiently that they do not penetrate the target rounds.

In principle, it is possible to degrade the fragment threat by providing some sort of armor package (an earth covered igloo, for example) about the stores which must be protected, or by introducing berms or barricades between possible fragment sources and target stores, or by attaching shield packages to the periphery of possible sources of fragmentation. For stores emplaced upon collocated units of rolling stock, it has been found that an efficient way of degrading the fragment threats to a level which will not cause propagation of detonation from vehicle to vehicle is to attach shield packages to the periphery of the possible fragmentation sources on each vehicle. This approach is recommended here to reduce the probability of propagation of detonation from

vehicle to vehicle by means of fragment impact. Appropriate spacing is then required to eliminate propagation of detonation from vehicle to vehicle by means of crushing loads.

#### RECOMMENDED LOAD CONFIGURATIONS

A shield configuration, designed specifically for pallets of M106 8" projectiles is shown in Figures 1-4. Note that the shield intrudes into the vertex formed between each round pair. This portion of the shield is absolutely necessary in order to prevent very high velocity, hazardous fragments from being ejected from these regions. Emplacement of the shields on the pallets for a typical configuration is shown in Figure 4. Shields are to be fabricated locally. Solid polyethylene or polypropylene, at a density of 0.8-1.4 g/cc (this covers most of the range of commercially available nonporous forms of these materials) can be used. Note that we do not recommend using plastic shields on pallets to prevent within-vehicle propagation. Propagation of detonation by fragment impact between rows of pallets of projectiles aboard any one vehicle can be prevented by using propelling charges as fragment barriers. Propelling charge cans are stored in a vertical configuration for this purpose. Some propelling charges are restricted from vertical storage; such charges should not be used between pallet rows, but can be placed at the rear of the vehicle, or in any other available space. Spacing and maintenance of free surfaces to the sides and above are required to prevent propagation of detonation via a crushing mechanism. This is effectively achieved in the configurations shown in Figures 5-9.

Schematics for combat loads of 8" assets for various vehicles are shown in Figures 5-9. Assets are configured such that each row of projectile pallets is separated from other projectiles on the same vehicle by propelling charges which interrupt line-of-sight fragment trajectories. The spacings provided by the rows of propelling charges were chosen to prevent propagation via crushing mechanisms, and may not be reduced, if more than one row of projectile pallets is to be prevented from detonating.

The spacings between vehicles should not be less than 15 feet, when configured as shown. Shorter distances will not only increase the probability of vehicle to vehicle propagation of detonation, but will also increase the damage radius, in terms of explosion ejecta distances, and the extent of damage done to neighboring vehicles and ammunition assets. Since damage to neighboring assets decreases rapidly with increasing distance of separation; wherever possible, the distance of separation should be greater than 15 feet. For example, in tests involving 40 ft S&P trailers loaded with 8" stocks the explosion of one row of pallets of 8" shell, with corresponding amounts of propellant was enough to completely destroy neighboring trailers located 15 ft away, although the explosion did not propagate to any shell other than those which were deliberately detonated. For similar detonation source sizes, we estimate (without supporting data) that trailers located 50 feet away would survive with minimal damage.

#### PAYOFF

When 8" artillery ammunition is configured as recommended here, with shielding emplaced on pallets as shown in Figure 5, and with vehicles emplaced with separation distances not less than 15 feet, the maximum credible event is

reduced to the detonation of one unit of pallets of 8" shell and neighboring propelling charges. Thus, the blast radius is based on the net explosive weight of a fraction of a vehicle load, rather than upon the total net explosive weight of collocated 8" assets. The fragment hazard radius to personnel is not reduced below the standard distance.

When vehicles are separated by spacings as small as 15 feet, nearest neighbor assets and vehicles must be considered sacrificial, although such assets (if 8" M106) will not detonate. No data exists to permit accurate description of the damage to second nearest neighbor vehicles and assets. Based upon damage to the first nearest neighbors, it is estimated that assets aboard second nearest neighbor vehicles would suffer sufficient damage to render them at risk for use. Assets further removed would be expected to survive with minimal damage. Since damage due to blast decreases rapidly with increasing distance of separation from the source, it is recommended that distances of separation much larger than 15 feet be used, consistent with operational requirements. For example, if space permits, a separation of more than 50 feet between loaded vehicles is recommended.

The situation described above contrasts favorably with the situation where no protective measures are taken: In the latter instances detonation of all assets loaded on the source vehicle will occur, and propagation of detonation from vehicle to vehicle will occur with resultant mass detonation of essentially all assets collocated within the ammunition holding area.

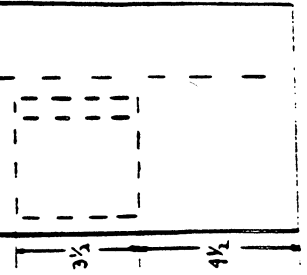
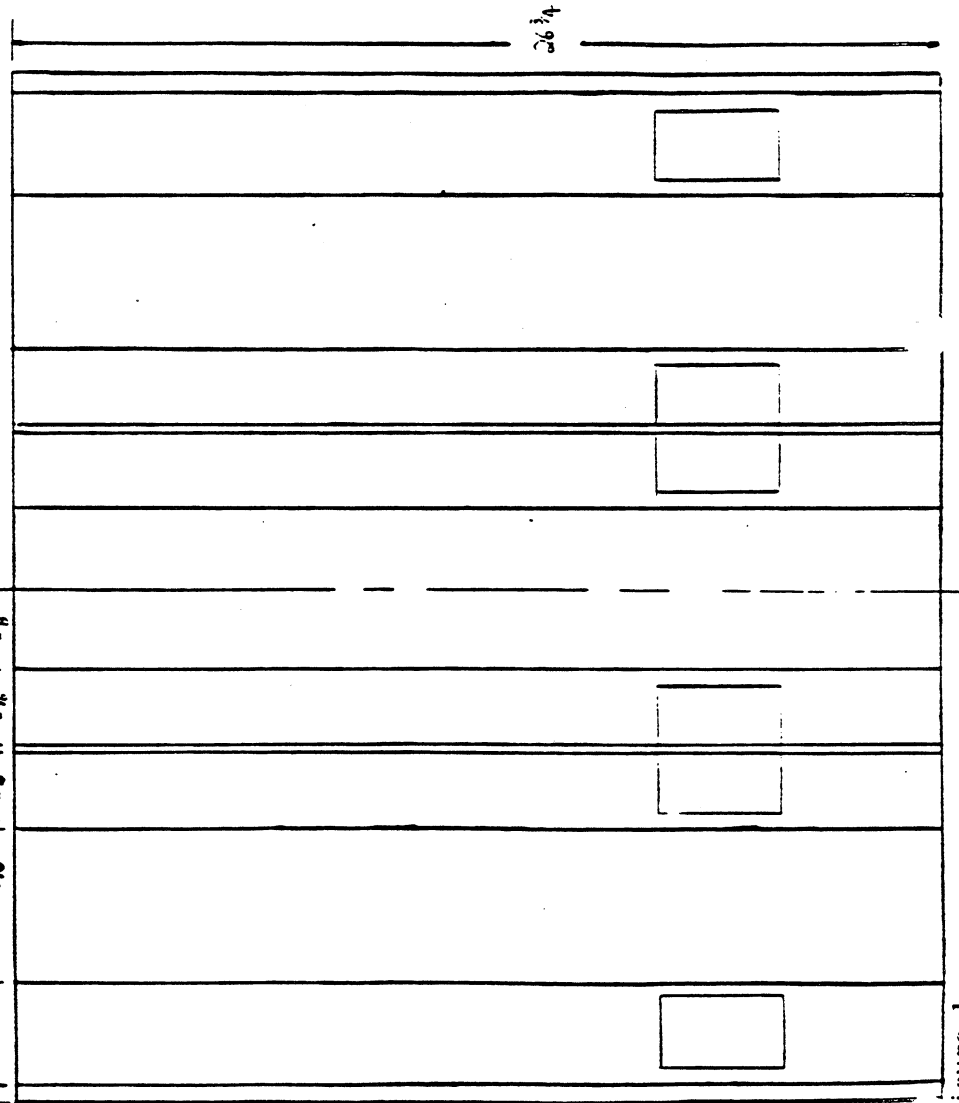
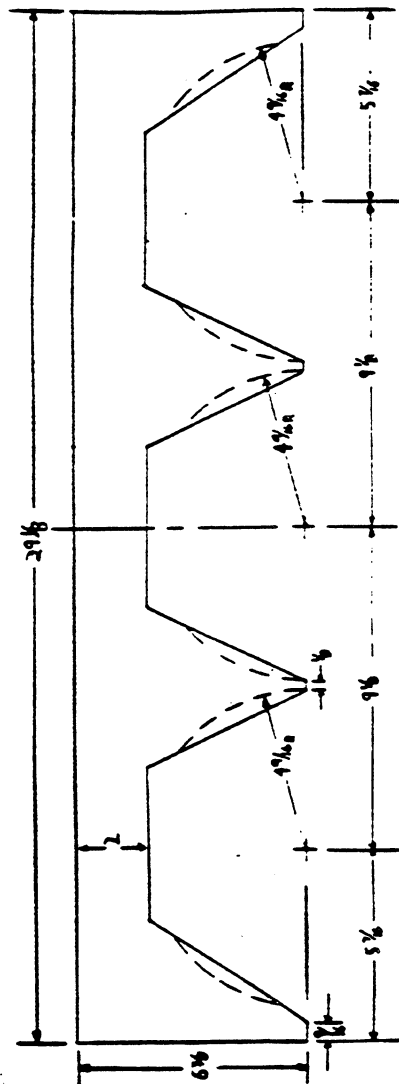
Note that the fragment hazard radius is not reduced by these measures, as no effort has been made to contain primary or secondary fragments. The blast radius can be reduced significantly. If no other types of unprotected stores are located within 100 feet, the blast radius can be calculated assuming that one unit of pallets of 8" projectiles and all the propellant aboard the detonating vehicle contribute to the NEW. If stores of other types of munitions are emplaced nearby, NEW will have to be estimated on a case by case basis.

# QUICKLOAD

## SHIELD FOR

8 INCH HE

M106



NOT SCALED

Figure 1.

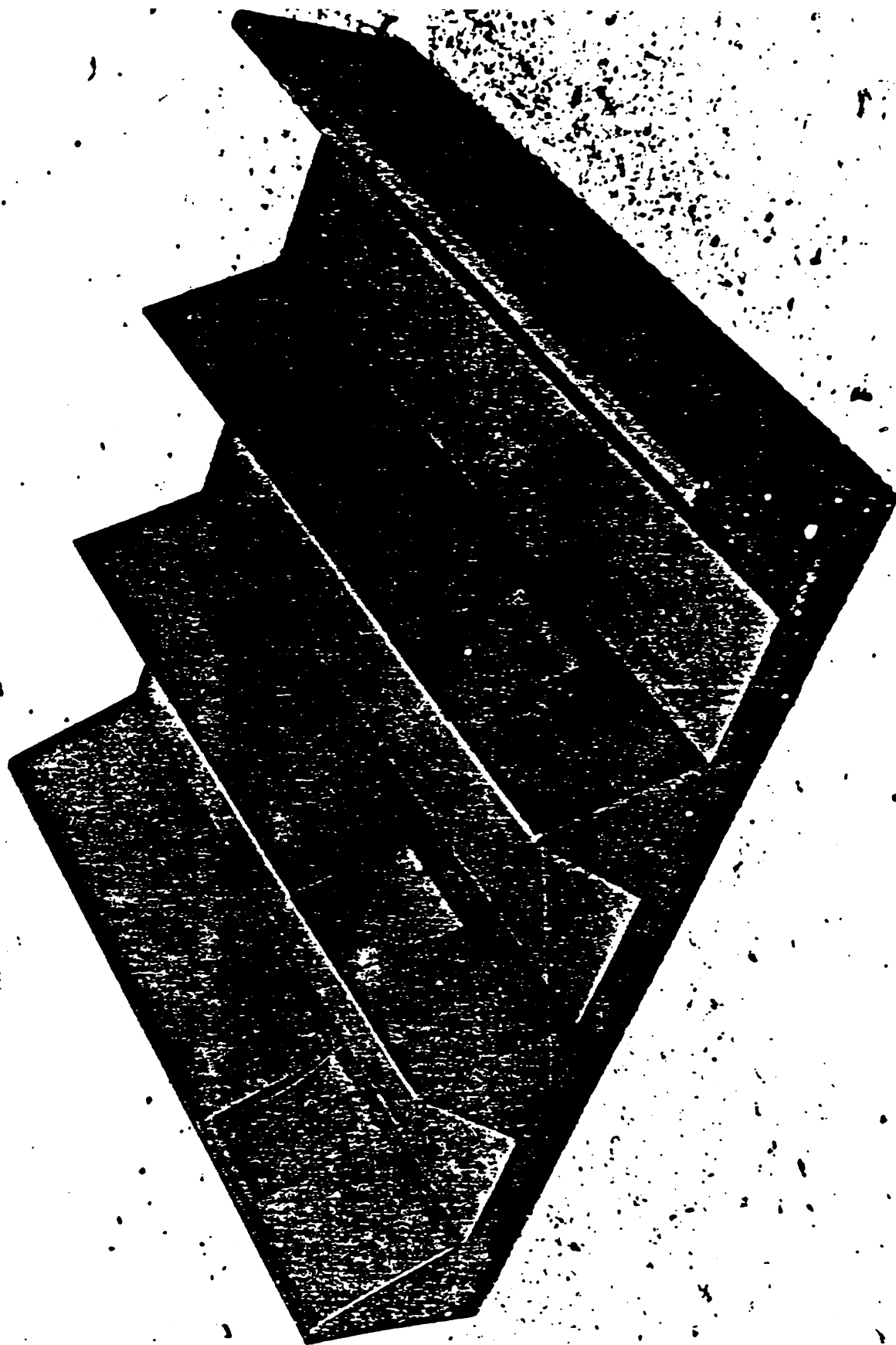


Figure 2.

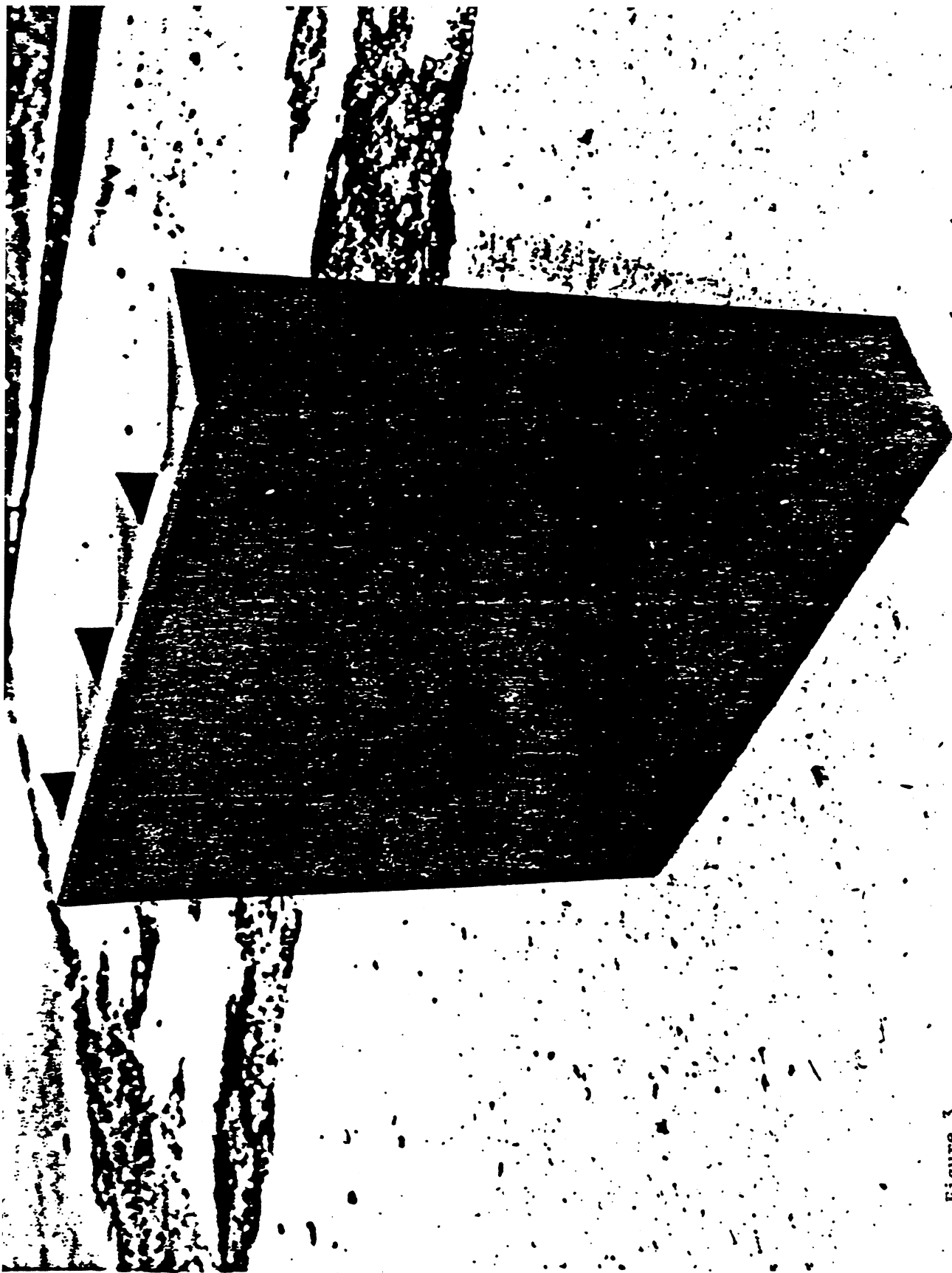


Figure 3.

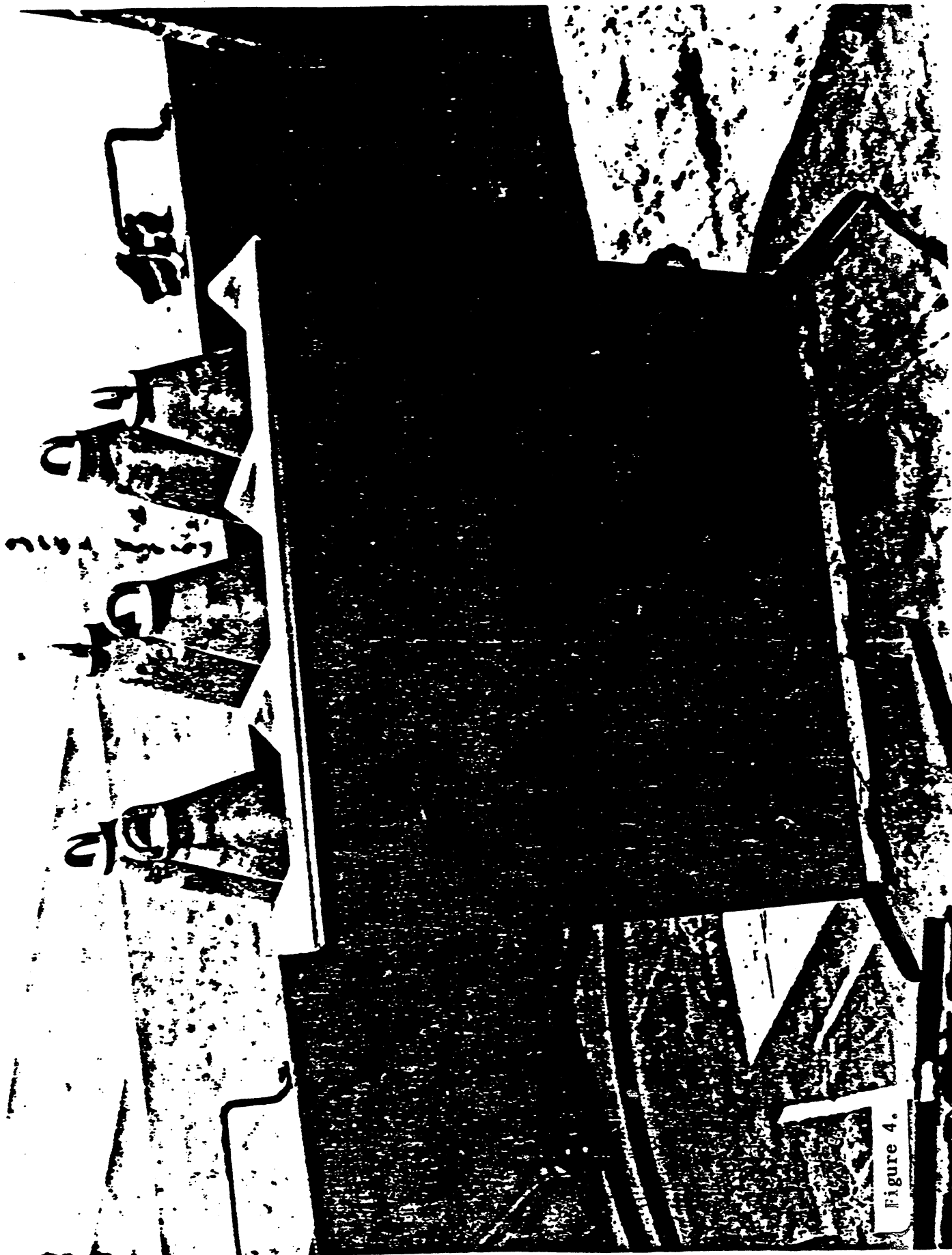


Figure 4.

# HEMIT

## 10 TON TRUCK W/8 INCH ARTY

13 PALLETS x 6 = 78 PROJOS = 16,380 lbs

98 CANISTERS

29 GREEN x 34 lbs = 986 lbs

69 WHITE x 54 lbs = 3,726 lbs

SHIELD WEIGHT = 756 lbs

(POLYETHYLENE/POLYPROPYLENE @ APPROX. 65 lb/ft<sup>3</sup>)

21,848 lbs TOTAL: MAX. AUTH. WEIGHT 22,000 lbs

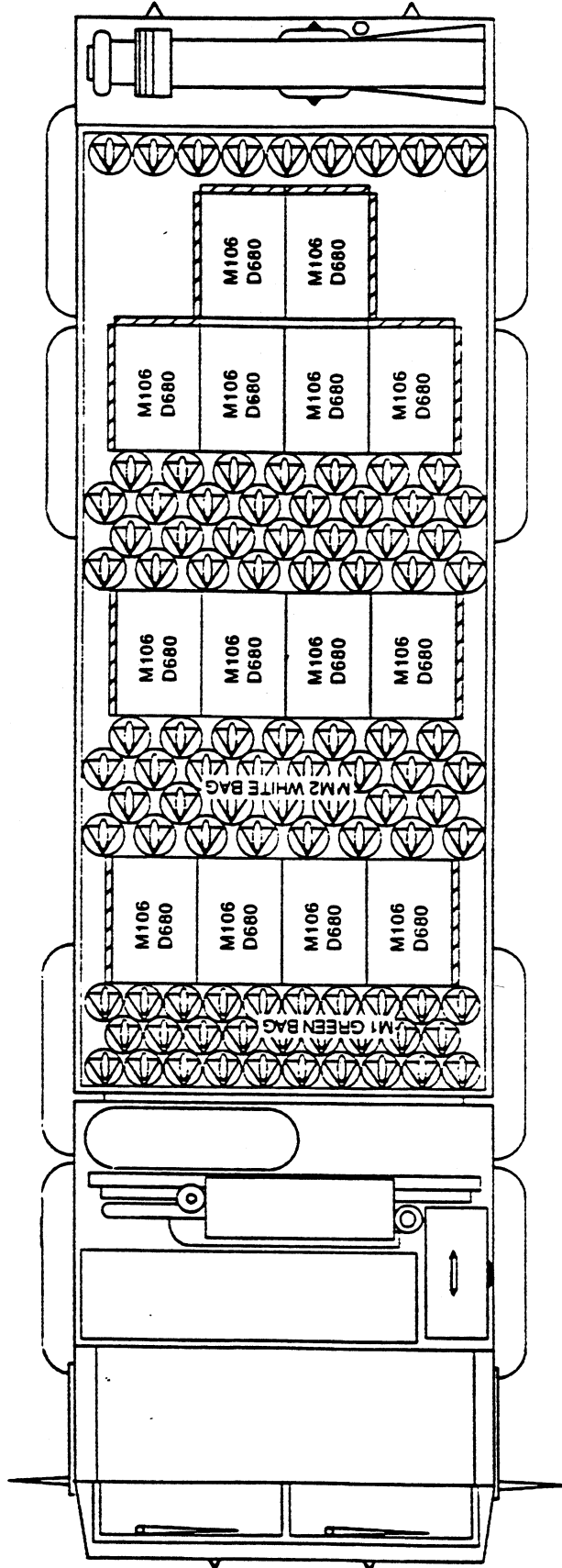


Figure 5.

1.5 TON AMMO TRAILER W/8 INCH ARTY

2 PALLETS x 6 = 12 PROJOS = 2,520 lbs  
 20 CANISTERS  
   8 GREEN x 34 lbs = 272 lbs  
   12 WHITE x 54 lbs = 648 lbs  
 SHIELD WEIGHT = 382 lbs

(POLYETHYLENE/POLYPROPYLENE @ APPROX. 65 lb/ft<sup>3</sup>)

3822 lbs TOTAL: MAX. AUTH. HIGHWAY 5,500 lbs

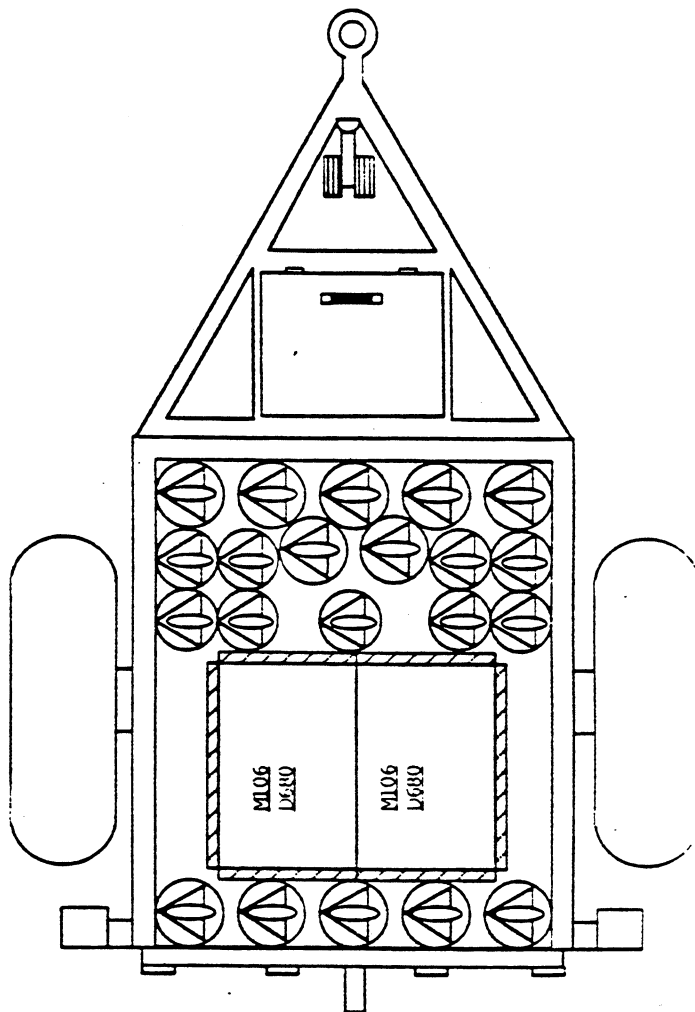


Figure 8.

5 TON TRUCK W/8" ARTY

10 PALLETS x 6 = 60 PROJOS = 12,600 lbs

73 CANISTERS

19 GREEN x 34 lbs = 646 lbs

54 WHITE x 54 lbs = 2,916 lbs

SHIELD WEIGHT = 659 lbs

(POLYETHYLENE/POLYPROPYLENE @ APPROX 65 lb/ft<sup>3</sup>)

16,821 lbs TOTAL: MAX AUTH. HIGHWAY 20,000 lbs

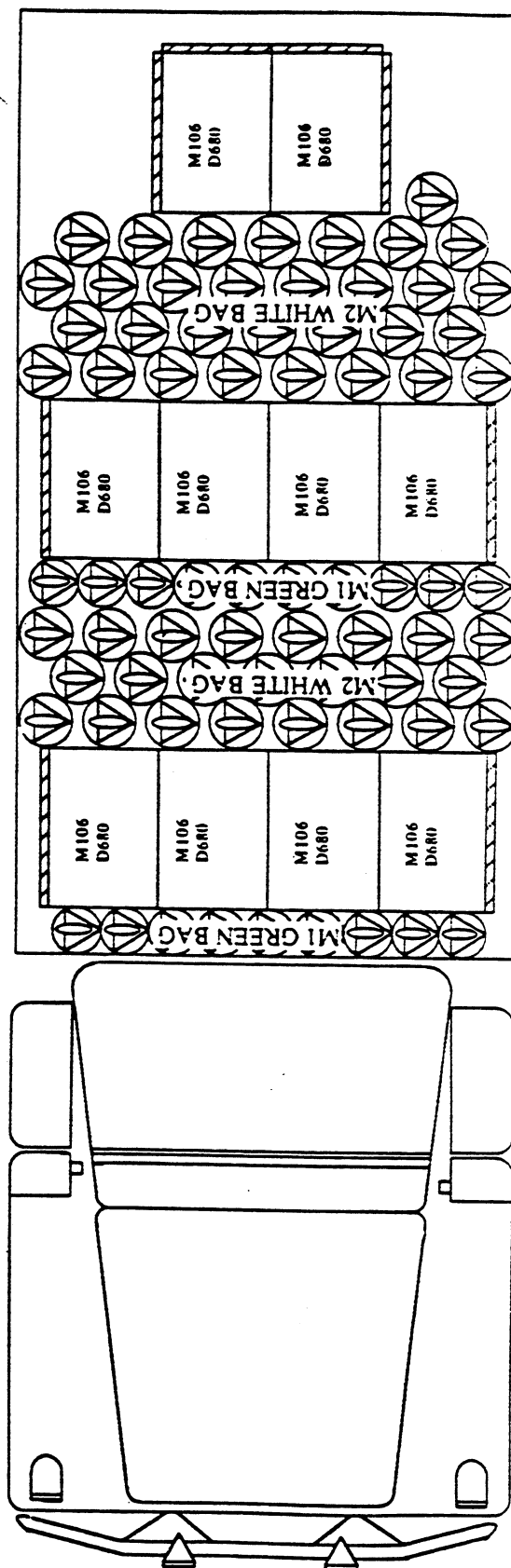


Figure 9.

# LIFTMAT

## 10 TON TRAILER W/8 INCH ARTY

13 PALLETS x 6 = 78 PROJOS = 16,380 lbs

98 CANISTERS

29 GREEN x 34 lbs = 986 lbs

69 WHITE x 54 lbs = 3,726 lbs

SHIELD WEIGHT = 756 lbs

(POLYETHYLENE/POLYPROPYLENE @ APPROX. 65 lb/ft<sup>3</sup>)

21,848 lbs TOTAL: MAX. AUTH. WEIGHT 22,000 lbs

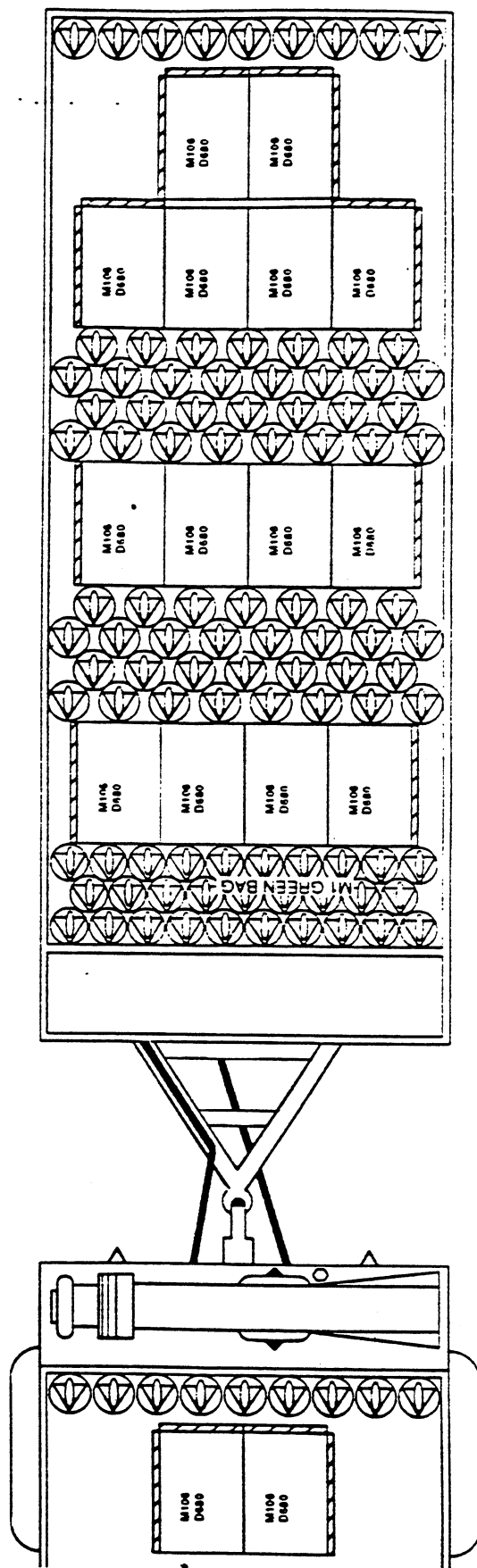


Figure 6.

12 TON SEMI-TRAILER W/8 INCH ARTY

20 PALLETS x 6 = 120 PROJOS = 25,200 lbs

145 CANISTERS

45 GREEN x 34 lbs = 1,530 lbs

100 WHITE x 54 lbs = 5,400 lbs

SHIELD WEIGHT = 1,131 lbs

(POLYETHYLENE/POLYPROPYLENE @ APPROX 65 lb/ft<sup>3</sup>)

33,673 lbs TOTAL: MAX. AUTH. HIGHWAY 36,000 lbs

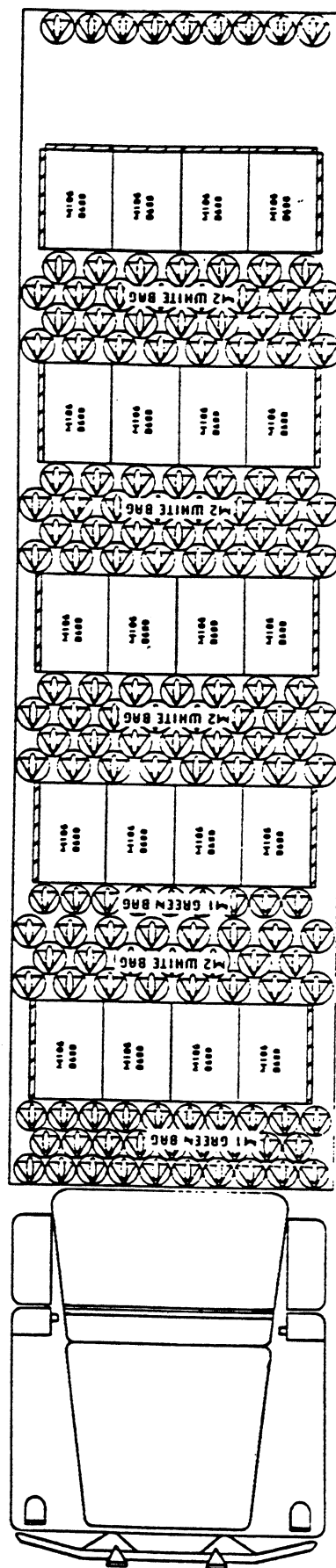


Figure 7.

